

Exploring the Morphological Characteristics of Urban Open Spaces at the Neighborhood Scale in Patiala, Punjab

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ABSTRACT

In the ever-changing patchwork of metropolitan surroundings, there are less and fewer sites suitable for future development. It is our duty to make sensible use of urban environments, valuing and maximizing their natural attributes. Every urban area has a unique personality that is shaped by the peculiarities and traits of its psychology. It becomes clear from a historical viewpoint that urban open spaces adapt to new applications and technological advancements. Sadly, these significant public spaces are slowly losing their quality because of problems including misuse, inappropriate use, and social problems involving their dynamics. Different cultures and faiths have an impact on the diversity observed in urban open spaces (UOS) [1]. Morphological determinants [2] are important in establishing the feeling of place in these locations. It is vital to acknowledge that comprehending UOS necessitates considering the created mass and its confinement [1]. The relationship between UOS and its activities profoundly influences the entire urban layout of a city. Together, social groups, political organizations, and local communities may be able to stop the decline and revitalize these locations. Coordinated efforts can be used to renew and reactivate urban open spaces, ensuring their continued importance as integral components of our urban landscapes.

Keywords: Urban open space; Sense of place; Revitalization; Urban landscape; Morphological determinants; Social groups; Social relationships; Patiala; Built environment; Social concerns.

1. Introduction

To meet their complex social, economic, and cultural needs, civilizations are expanding quickly. Social relationships have a crucial role in maintaining the coherent fabric of society and promoting communal cohabitation. In this intricate situation, land becomes an essential natural resource and a vital resource for humans. The result of both intentional design and unplanned development over time is the modern metropolitan landscape. Every square inch of space in this urban tapestry has been carefully chosen and use, creating a harmonious blend of natural areas and constructed buildings. Urban open spaces (UOS) are crucial, shaped by both the wider public domain and morphological components. Urban areas must be functional to accommodate a wide range of public demands and serve as the foundation for public amenities. These open areas host a plethora of urban activities that greatly enhance the liveability of the urban environment. These areas add to the rich diversity that defines the public realm as they dynamically change across temporal and spatial dimensions. The urban open space system's effectiveness and its relationship to the surrounding built environment are critical components of the sustainability of cities and the areas that surround them. To promote sustainable urban growth and improve the standard of living for residents, it is imperative to acknowledge the significant influence that these areas have on the entire urban environment.

1.1. Study Objectives

Urban morphology, planning techniques, their outcomes, and shifts in the urban planning and urban design scenarios in current cities are all directly impacted by the intense pressure to alter and modify the urban

environment and the primary component of urban open spaces. Given the significance of human settlements in a nation's morphological and cultural evolution, this dynamic is particularly prevalent in cities with a strong cultural and historical presence. As a result, the objectives with which this study has been conceptualized to attain its aim for Exploring the Morphological Characteristics of Urban Open Spaces at the Neighborhood Scale, are as follows:

- (i) To understand the idea of Urban Open Space and its system for cities,
- (ii) To understand and analyse the challenges of these spaces in a cities morphology,
- (iii) To synthesis the dynamics of urban open spaces with reference to the urban design and structural system of city growth and its topography,
- (iv) To recommend the way forward for making these spaces more human centric and in appropriateness of their use, location, urban morphological connect and topographical justifications making then efficient in all dynamism of their existence.

To take this further it now becomes imperative to discuss on the historicity of these spaces, their evolution, genesis, cultural and historical dynamics, challenges and the process of their existence and impact on the fabric of a city to work out the methodology and recommendations as to what needs to be done to achieve efficient and use appropriate urban open spaces.

2. Genesis and Historical Development of Urban Open Space System

Across epochs, spanning from ancient civilizations to contemporary urban landscapes, urban open spaces exhibit a dynamic nature [3]. The characteristics of these spaces have evolved through various historical periods, including Roman and Greek cities, Baroque and Renaissance cities, Medieval cities, and today's contemporary urban environments. This perpetual dynamism stems from the changing needs of society and technological advancements [3]. Patiala, positioned as a princely state in the South-Eastern part of Punjab, boasts a rich historical tapestry. The city, well-connected by roads and situated approximately 75 km southwest of Chandigarh, has roots that extend back nearly 250 years.



Figure 1. Existing land use plan

Source: [6]



Figure 2. Hierarchy of streets

Source: Author

Despite its relatively fresh settlement status, Patiala holds ancient historical significance, dating back to the time of Harappan settlements (2000 B.C. to 1500 B.C.). Founded by Baba Alla Singh, Patiala originated as a walled city, now renowned for its historic areas and surrounding bazaars [4]. Over time, the city has undergone outward expansion [3, 5]. In the contemporary era, the transformation of cities like Patiala is influenced by the latest trends and techniques, marking a shift towards modern urban planning and development [3]. This evolution reflects the adaptability of urban spaces to the ever-changing needs of society and the application of cutting-edge technologies in urban design and infrastructure.

Illustrated above in Figure 1 for land use and Figure 2 depicting the hierarchy of streets, the Tafazalpur area, along with Guru Nanak Nagar, Gurbax Colony, and Bishan Nagar in Patiala city, Punjab, seamlessly amalgamate to create a cohesive neighborhood. Specifically, the Tafazalpur area has a unique historical evolution, originally established to accommodate railway station workers. Situated on the periphery of a river bed locally known as "Choti Nadi" (Small River), this area serves as a distributary to the "Badi Nadi" (Primary River). Notably, its proximity to the railway station and bus stand enhances its accessibility.

The land use within this neighborhood is diverse, encompassing dedicated residential areas and mixed land use zones, incorporating a blend of shops and offices. This mix of land use contributes to the dynamic nature of the urban pattern in this locality, characterized by a combination of organic development and a grid layout. The coexistence of various functions within the Tafazalpur area reflects a thoughtful integration of residential and commercial elements, creating a multifaceted urban environment that caters to the needs of its inhabitants.

3. Urban Open Space Challenges: A Comprehensive Examination

Within the domain of Urban Open Spaces (UOS), numerous difficulties extend from the broad city level to the detailed area level, creating a complicated picture that necessitates careful examination. The urban landscape is diverse, with problems ranging from overpopulation, small streets, and unused spaces to an overreliance on vehicles and buses for mobility [3]. The imbalance in transportation usage, which places too much emphasis on vehicle traffic and not enough on pedestrian paths, is one common cause for concern. The priority of high-speed automotive roads over pedestrian systems and their critical role in creating sustainable and liveable urban places frequently exacerbates this disparity [7]. Urban open spaces are being degraded by encroachments by residential and commercial buildings, parking that is not permitted, improper drainage systems, and the improper use of open spaces and vacant plots as trash yards [3]. In heavily populated metropolitan areas, this degradation is exacerbated by overcrowding, increased vehicle intensity, and consequently raised carbon footprints that represent a substantial environmental hazard [8]. The combined consequence of these problems is pollution in the land, air, and water, which reaches peak levels and makes the environment uninhabitable for people as well as a haven for serious health problems. The complex interactions between these problems have a major influence on the region's overall sustainability and quality of the environment [8]. Examining, understanding, and working towards resolving these complexities provides a rare chance to decipher the complex dynamics and suggest creative solutions for improving and developing urban open spaces sustainably, which is essential to creating sustainable cities that are more intelligent and meet the needs and ambitions of their stakeholders.

3.1. Understanding the Morphology of Urban Open Spaces: Unveiling the Dynamics

Urban open spaces have a crucial role in creating the identity of a city within the complex web of urban surroundings. They form a visual story that flows naturally from structural features to other aspects [3]. The way urban open spaces are shaped falls into a critical role in this framework, impacting overall land use patterns and creating a dynamic interplay with commercial structures. Plot configurations for commercial buildings create variability within the larger context of land use. The physical configuration of a large, open metropolitan area comes together to form unique urban patterns. The distinct sense of place within this urban area is defined in part by the interaction of many morphological variables, such as scale, geometry, land use, building structures, plot patterns, and street layouts [1].



Figure 3. Land use plan of main street

Source: Author

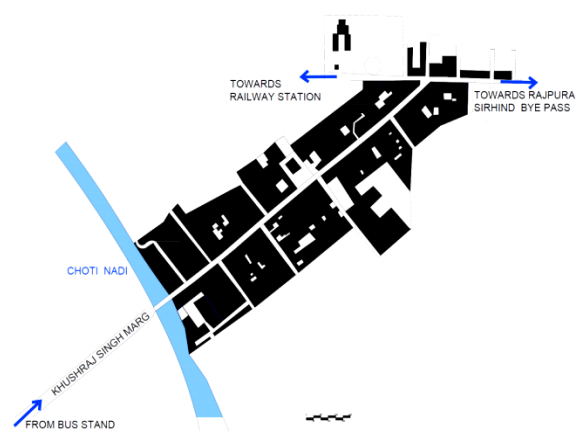


Figure 4. Built mass-open space relationship

Source: Author

The major street, which separates Tafazalpura from Gurbax Colony and is primarily used for business purposes, is summed up in Figure 3. This highway is lined with a mosaic of public and commercial buildings, including gas stations, banks, and hospitals. This busy street, which is an extension of the stores, develops into a bustling marketplace that serves the requirements of the locals who live close to the major thoroughfare. The complex interplay between constructed mass and open space along the main street depicted in Figure 4 offers important insights into the accessibility of landscape areas or breathing spaces for nearby users. Nonetheless, the research indicates a concerning pattern: the existence of these kinds of open areas is essentially non-existent. The dearth of Urban Open Spaces (UOS) highlights the built environment's hegemonic dominance and suggests an imbalance in the structure of the city. In the process of dissecting the intricacies of urban morphology, the investigation illuminated the vital function that urban open spaces perform in upholding a harmonious equilibrium within the constructed surroundings. The results emphasize the necessity of deliberate actions to increase UOS presence and maintain a healthy, balanced urban environment.

3.2. Exploring the Dynamics of Urban Morphology through Built Mass and Open Space Relations

When it comes to urban morphology, the complex relationship between constructed mass and open space interactions provides fascinating new perspectives on the city's structural makeup. The size of building blocks and the ratio of building height to building width to open space are notably small in some regions, exhibiting a

noticeable trend. This finding confirms the high population density and the resulting creation of a densely populated urban environment. This specific land-use scenario takes place in a variety of settings along the market streets, giving the neighbourhood a lively sense of urban variation and activity. Due to their market street layout, these streets are always lively, except at night when they are not as busy. But around rush hour, things take a turn for the worst as traffic jams make it difficult to move through the streets. During rush hour, traffic is particularly heavy on these busy streets because they are the only route to the Rajpura road bus stand. One gas pump is depicted in Figure 5 as a beacon, a place where people might find refuge from the built environment. But a different reality emerges as the trip moves closer to the living quarters. The residential area's small streets, which wind through it, provide little to no open space, further tightening the urban layout's limitations. A sophisticated comprehension of the dynamic urban morphology is offered by this investigation of the relationships between constructed mass and open space. Striking a delicate balance between land use, infrastructure, and population density becomes essential to the goal of sustainable urban growth. As we disentangle these dynamics, it becomes clear that actions are necessary to maximize the spatial linkages and improve the urban environment's overall quality.

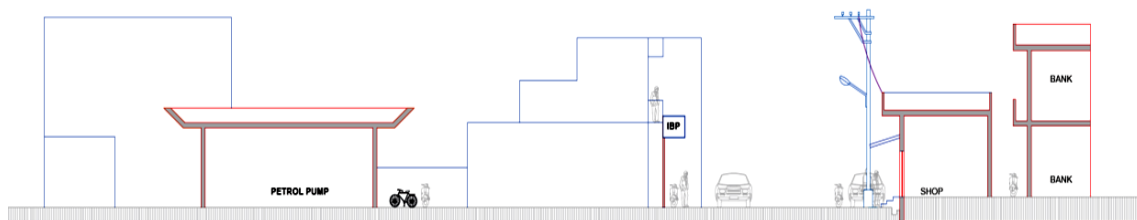


Figure 5. Section through primary road dividing Gurbax colony and Tafazalpura

Source: Author

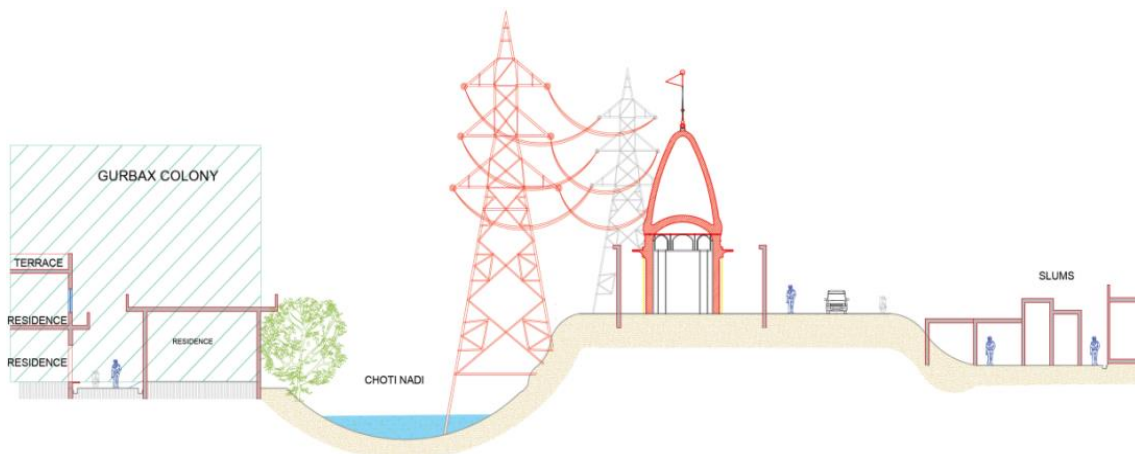


Figure 6. Section through Gurbax Colony, Choti Nadi, Bandh, slums

Source: Author

When it comes to urban morphology, Tafazalpura has a dense urban form with constricted areas, limited streets, and a noticeable loss of identity. Gurbax colony, on the other hand, displays a somewhat less dense urban form. Gurbax colony's main thoroughfares are congested during peak hours due to the predominant land-use activity in the area—commercial and mixed. The way a city's neighbourhoods grow depends on several elements, including population density, changing requirements of society, and new methods and trends. Urban amenities and future

projections are also important factors to consider while managing urban pressure. Different patterns are created by the way streets link inside a community. These patterns include the radial, concentric, gridiron, and curvilinear patterns. The factors of walkability, variety, liveliness, degree of openness, urban furniture, accessibility, and physical exercise are essential to the urban fabric of Patiala's neighbourhood areas. These qualities are essential in forming and improving the standard of urban open spaces. Specifically, the lack of these elements increases the vulnerability of urban open spaces in the Patiala neighbourhood areas. Thus, cultivating sustainable and resilient urban settings in the context of Patiala requires a thorough grasp of the complex dynamics of urban morphology, street patterns, and the careful management of essential qualities in open spaces.

Figure 6 shows the cross-section of the edge road that is next to the "Choti Nadi." The diagram's right-hand illustration makes it very evident how dangerously close the Gurbax colony is to the wastewater drainage pipe. In addition to making the colony's edge unfit for residential use, this proximity puts people at serious risk during flood disasters. Notably, the edge road includes a temple that serves the surrounding neighbourhood as well as the residents of the slum. Slums are clearly defined on the other side of the Gurbax colony, which is located on the left side of the cross-section. This thorough representation of the cross-section sheds light on the Gurbax colony's precarious location and offers insightful information on the urban open space system along this specific edge. The drawing also provides an overview of the wider urban landscape that surrounds the drainage line. The combination of these elements in Figure 6 highlights the complex relationship that exists between urban expansion, environmental factors, and open space use in the setting of the edge road that runs beside the "Choti Nadi." This knowledge is crucial for making educated decisions about the resilience and design of urban areas, especially those that are vulnerable to environmental problems like flooding and drainage problems.

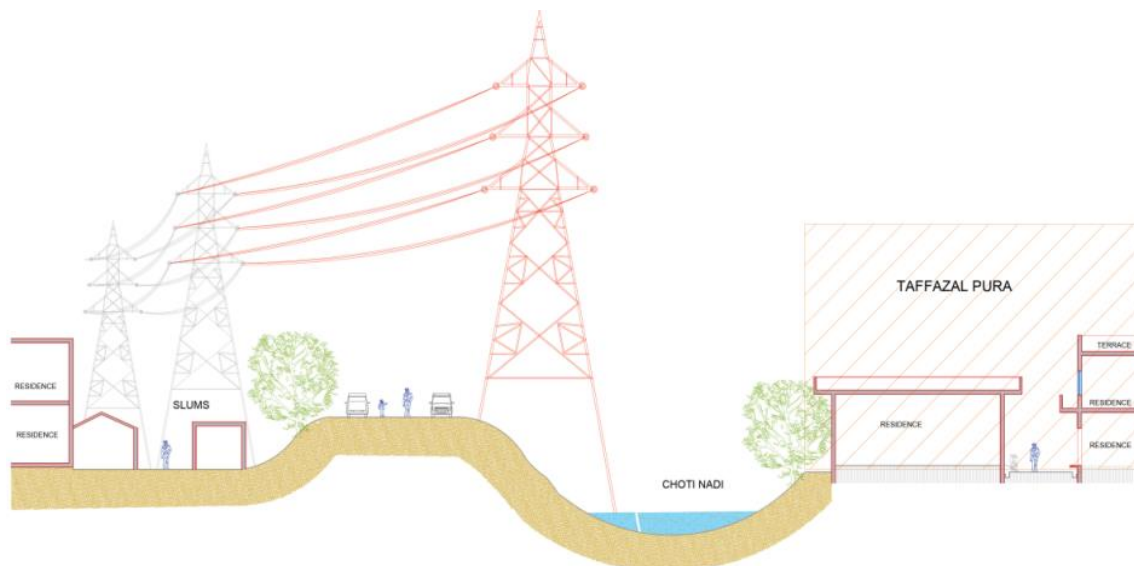


Figure 7. Section through slums, Bandh, Choti Nadi, Tafazalpura

Source: Author

Even though the wastewater drainage line is covered with a slab and turned into a landscape area above it, Figure 7 depicts the cross-section across the other side of the major road in which the Taffazalpura region pays a severe price (health and safety). The unsanitary conditions and illegal slum settlement cause a true catastrophe.

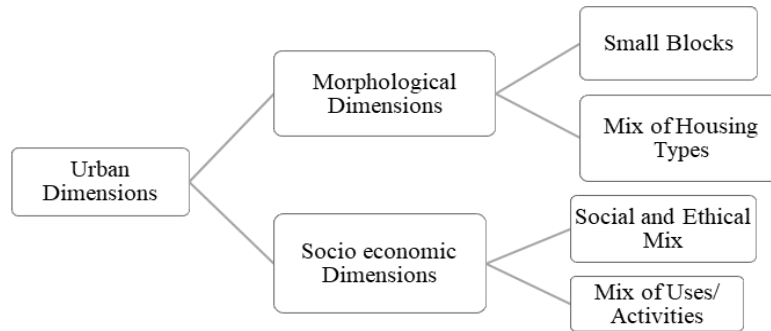


Figure 8. Urban dimensions

Source: Author

Different urban morphological measurements are dependent on spatial features including the "size, composition, and intensification of the built-up area in the neighbourhood," as stated in Table 1. Important elements such as "road intersections, road density, building volume, percent greenery, and compatible land use mix" are included in these measurements [13]. The use of urban dimensions required to create high-quality urban open spaces (UOS) in neighbourhoods is explained in Figure 8.

Table 1. Morphological Elements and Measures of UOS

Morphological Elements	Morphological Measures
Buildings	Space Matrix
Plots	Spatial Components
Streets	Space Syntax

(Modified By: Author) [12]

An urban area's vitality is closely linked to several aspects and features of its urban form, including factors such as size, use, and aesthetics [14]. In this setting, urban open spaces are crucial because they can function as both places for social gatherings and possible homes for the impoverished. The formation of urban form depends not only on their physical presence but also on legibility, which is defined by a number of factors such as users, events, location, and spatial conditions [15]. It is essential to comprehend and incorporate these urban morphological dimensions and measures while designing lively and long-lasting neighbourhoods. Planners and lawmakers are better able to deliberately create urban open spaces that meet the many demands of the community when they have a thorough understanding of the spatial qualities and essential components that support urban life.

Table 2 given below outlines the ways in which traits and metrics of urban open spaces interact to influence the surroundings for different kinds of activity. These distinguishing characteristics have a significant impact on the urban form, especially regarding patterns of activity. To maintain safety and comfort, urban open space management requires treating each place as a conduit for movement, encouraging user participation, and optimizing activity patterns. In this setting, urban vitality becomes crucial since every attribute adds to the unique identity and character of the urban morphology, bringing life to the public domain inside urban open spaces. It is crucial to strike

a healthy balance between the many kinds of urban open spaces, including streets, parks, public buildings, back and front courtyards, centre courtyards, edge roads, waste drainage areas, institutional grounds, and religious open spaces. This strategy entails understanding the needs and dynamics connected to every kind of urban open space. Planners and designers can build surroundings that not only support a variety of activities but also add to the overall liveability and vitality of the urban landscape by carefully analysing the features that characterize these areas. This emphasis on inclusivity and balance highlights how important it is to manage urban open spaces holistically for the good of the community.

Table 2. Characteristics of UOS, its Indicators, Observations and Solutions for UOS

Characteristics of Urban Open Spaces	Indicators	Observations and Solutions of UOS at the Neighbourhood Level
Walkability	Pedestrians at every artery of the urban area, Pedestrian access to every type of open space, use of attractive materials on footpaths.	No dedicated pedestrian pathways at neighbourhood level streets.
Variety and Vitality	Importance can be increased as we incorporate a variety of components and elements like street like planters, design of street lights, design of street furniture etc., Incorporate the leisure elements like water bodies etc.	Less variety in spaces i.e. variety in types of parks Needs to incorporate the new elements which might increase the importance of the urban space.
Level of Openness	Use of Gazebos as per the openness of the area, Conserve more green area for sitting, relaxing and enjoyment Se trees as per the height to width ratio of the enclosed urban open spaces.	The level of openness in this area is less and some areas are not managed properly.
Urban Furniture	Use of attractive colour of the furniture, Make the dedicated children playing areas, Placement of the urban furniture.	Urban furniture in the urban open spaces are not managed properly, More urban furniture needs to be placed for sitting, relaxing, and enjoyment.

Accessibility	<p>Accessible for all like every age group,</p> <p>Access for disabled persons,</p> <p>Dedicated space for vendors,</p> <p>Placement of Streets lights in streets which are lying vacant,</p> <p>Transparency in the spaces.</p>	<p>Some parks lying vacant, only stray animals stay there which scares the children to access them,</p> <p>Standards for disabled person have not been used for the construction of urban open spaces.</p>
Enjoyment	<p>Use of food stalls as per the level of open space.</p> <p>Need more shady areas like canopy trees and artificial canopies,</p> <p>Need to include the water body and certain elements of landscaping.</p>	<p>Less no. of spaces found in which every age group is involved.</p> <p>Open gyms may also solve the purpose</p> <p>For children provide a musical fountain.</p>

(Modified by: Author)

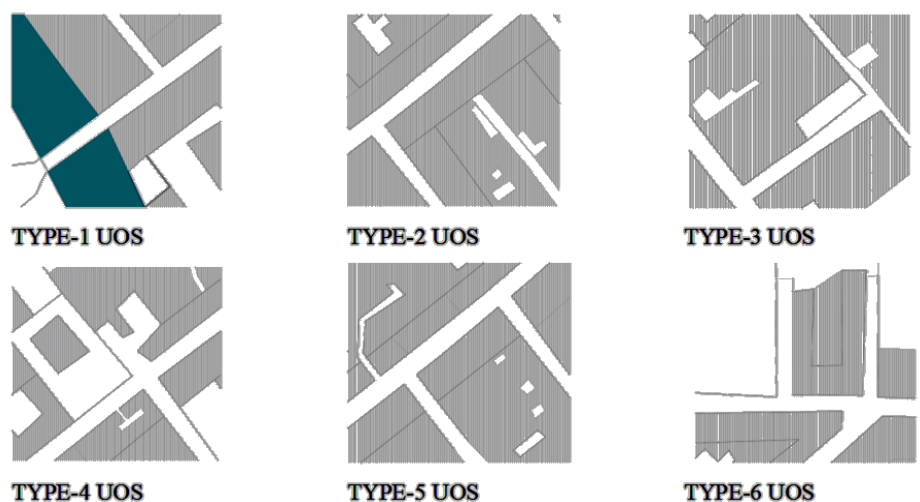


Figure 9. Typology of urban open space system of Neighbourhood

Source: Author

Every kind of Urban Open Space (UOS) has its own personality that is determined by the way its land is used, how its buildings are arranged, and how its streets are laid out. This dynamic in urban morphology is shown in Figure 9, which depicts the identity evolution from Type-1 to Type-6. Urban morphology is a dynamic element that continuously shapes its uniqueness and imparts a feeling of personality to the entire urban environment. Urban open spaces are dynamic environments whose identities change over time due to changes in their physical design, usage patterns, and temporality. This dynamic quality draws attention to how responsive and flexible urban areas are to the changing demands and goals of the local population. It is essential for urban planners and designers to

comprehend how urban open spaces are evolving. Through the understanding of the dynamic interaction among spatial, temporal, and functional aspects, they can create environments that are meaningful to the community and help to establish a feeling of connection and place. By accepting this flexibility, urban open spaces are guaranteed to stay relevant and make a beneficial contribution to the changing urban fabric over time.

As demonstrated in Table 3, the categorization of Urban Open Spaces (UOS) into different kinds offers a thorough understanding of the varied elements that form the urban fabric. The existence of "Choti Nadi," an urban water waste conduit, is incorporated into Type-1 UOS. Beside this canal, slums appear; these are usually built by impoverished people and lack basic facilities for sanitation. "Streets" in Type-1 refers to both residential and commercial streets that are used to strategically guide traffic toward various land-use building types. Furthermore, "public parking" spaces are reserved for driving and are sometimes used by sellers.

Table 3. Type of UOS Pocket in Every Category of UOS

Types of UPS	Streets		Choti Nadi	Parking Spaces	Petrol open spaces	Court-yards	Open Green Spaces	Chauraha- (Cross-junction)
	Residential Streets	Commercial Streets						
Type-1	✓	✓	✓	✓		✓		
Type-2	✓	✓				✓		
Type-3	✓					✓		
Type-4	✓	✓		✓	✓	✓		
Type-5	✓	✓				✓		
Type-6	✓	✓				✓	✓	✓

(Source: Author)

"Streets," which link residential and commercial districts and provide accessibility for a variety of spatial functions, make up Type-2 UOS. In addition, it has "Central and front courtyards" that are only meant for individual use and are not open to the public. Turning now to Type-3 UOS, it centres on "Streets" that serve primarily residential areas and emphasize traffic-related activities. Within this category, "courtyards" are set aside for the sole use of landowners and their occupants. Type-4 UOS is defined by "Streets," which are mostly commercial spaces that function as busy marketplaces that accommodate traffic and pedestrian traffic. This kind also includes open spaces next to banks set aside for parking two-wheelers, as well as a designated "Petrol pump open space," which is a public area mainly used for vehicle traffic. Type-5 UOS includes "Streets" with a curved street plan that travel through commercial market districts and heavily populated residential zones. In addition, it has "Courtyards," which are tiny, private areas available just to property owners.

In conclusion, Type-6 UOS incorporates "Street" elements, serving as the intersection of residential and commercial zones referred to as "Chauraha." This is an important intersection that links three different places. Furthermore, Type-6 includes a "Open green space" that is meant for public use and encircles the overhead water tank. The detailed categorization and explanation of different UOS types show the various features and purposes that contribute to the overall urban morphology, shedding light on the complex and multifaceted nature of urban areas. Comprehending these differentiations is imperative for efficacious urban planning and design, guaranteeing that every kind of UOS is tactically overseen and advantageously augments the comprehensive urban milieu.

4. Sustainable Urban Environment Solutions

When striving for sustainability in Urban Open Spaces (UOS), it is critical to conform to sustainable standards that are adapted to the unique requirements of the community [16]. Setting criteria for any type of land-use open space—residential, commercial, industrial, recreational, or mixed—becomes essential to supporting the improvement of UOS. Preserving the environment must be the top priority, and pollution of any kind—whether it be air, water, or soil—must be avoided. Contributing to sustainable urban development that is based on social, economic, and environmental principles ought to be UOS's main objective. Promoting social integration and inclusion is a necessary part of embracing social values [11].

Commercial values contribute through increasing worker productivity, integrating tourism, and merging commercial activities inside urban parks [8, 16]. In the meanwhile, protecting animals, maintaining plant and tree species, and reducing activities that pollute the air, water, and soil are all important aspects of environmental values. More broadly, sustainable cities examine how human activity affects the environment, especially when it comes to transportation, urban planning, and energy efficiency. Diverse land uses, a dense urban pattern, and a range of building components can all help to improve the image and sustainability of the urban environment and create a lively urban environment that is conducive to sustainability [16]. Adherence to sustainability concepts, principles, and key indicators is necessary to support social justice, balanced urban expansion, and social-economic mobility to ensure the sustainable development of UOS [17].

Many sustainability concepts that emphasize attributes like Sensitivity, Resilience, Adaptability, Flexibility, and Spatial Reorganization [17] have a significant influence on urban morphology. These concepts include Sustainable City, Green City, Smart City, Low Carbon City, and Eco City. Methodologies and frameworks for the sustainable development of urban open spaces must be developed immediately, given that sustainable urban development is a dynamic process. This entails creating criteria for solving problems that are relevant to metropolitan areas, both new and old, as well as their open spaces. Metropolitan planners and legislators may help create long-lasting, resilient, inclusive, and ecologically friendly metropolitan environments by adopting sustainable practices.

5. Conclusion

Urban open spaces inside neighbourhoods need to be revitalized and given new life [19], and this calls for an all-encompassing strategy that considers factors like safety, aesthetics, a variety of urban furniture, and efficient space management with the requisite infrastructure. To increase awareness and enhance the perception of urban

open spaces, it is imperative to incorporate sustainable elements and environmental controls using guidelines like the Urban Design and Planning Formulation of India (UDPFI) and Urban and Regional Development Plans Formulation of India (URDPFI), as well as to align with sustainable urban development goals [20, 21]. Building better alternatives, preserving the older ones, and renovating outdated urban open spaces are all part of the regeneration process.

Together, these initiatives give the community or society new vitality and improve the general effectiveness of the urban areas that are already in place. Creating a connection between the new and old open spaces is essential to attaining efficiency. To this end, applying typo-morphology techniques and incorporating them into comprehensive neighbourhood master [21] are critical stages. Urban Open Spaces (UOS) need to distribute these kinds of systems strategically and equitably across the city to function efficiently. By taking a proactive stance, problems like urban pressure, overpopulation, and other societal concerns are lessened. Urban planners and legislators may help create lively, sustainable, and peaceful neighbourhoods that meet the changing requirements and goals of the community by approaching the revitalization and regeneration of urban open spaces from a holistic standpoint.

The entire study clearly paves the way forward for all architects, planners and stakeholders associated with the city development and growth to take on the aspects of urban open spaces and understand them in totality and comprehensively in respect to their impact and resultants that these spaces face due to non-organized, unplanned and tabletop planning and designing initiatives being adopted in cities. Urban open spaces are the reflections of a city's identity and hence urban design initiatives, topographical features, and planning proposals and initiatives need to go hand in hand. The way forward for further research gives the scope to all concerned with city development to work on the importance of urban open spaces, their use appropriateness and mechanisms to maintain the use allocation of all urban spaces so as they justify the social needs, community interlinkages and also to further research on mechanisms and guidelines to make these spaces more relevant and contributory to the overall fabric of the cities especially the ones with rich cultural and historical importance and that too in the developing nations.

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Competing Interests Statement

The authors have declared no competing interests.

Consent for Publication

The authors declare that they consented to the publication of this study.

Authors' Contributions

All the authors took part in literature review, research, and manuscript writing equally.

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